colonies. These are startling facts, and go far to disprove Mr. Alder's doctrine, that the tube-like fold of the mantle is for the entry and regulation of branchial currents, which, even if they occasionally occur from spring tides and other causes, can only be in action for a very short time during the twenty-four hours. But I believe that in certain localities these creatures are not immersed in the sea-water for months together during the calms of summer. Many individuals of course inhabit lower levels, and will be more or less submerged.

Kellia rubra, then, may almost be considered a terrestrial bivalve. When it detaches itself from its hyaline delicate filamentary byssus, as it frequently does, to change place, food, and remove into more humid quarters, it is unable by its long slender foot to drag itself over the interstices of the fuci and the asperities or other matters in which it may happen to be settled without the aid of an additional power, which I am inclined to think is furnished by the extended fold of the mantle; and this supposition appears to receive strong support by the isochronal action of the foot and fold.

I am, Gentlemen, your most obedient servant,

WILLIAM CLARK.

XLVII.—*An Account of a Specimen of the* Vaagmaer, *or* Vogmarus Islandicus (Trachypterus Bogmarus *of Cuvier and Valenciennes*), *thrown ashore in the Firth of Forth.* By JOHN REID, M.D., Professor of Anatomy and Medicine in the University of St. Andrews.

[With a Plate.]

THIS fish was sent me on the 7th of April 1848 by Dr. John Berwick of Elie, near which place it was cast ashore dead. It was perfectly fresh when I received it; but the dorsal and caudal fins were damaged, and the ventral fins were entirely wanting—a condition, which, from the brittleness of these parts, is generally found in the adults of this genus of fishes*. Its characters showed distinctly that it belonged to the family Tænioïdes and genus *Trachypterus* of Cuvier and Valenciennes, and on comparing these with the descriptions of the species of *Trachypterus* given in the work of Cuvier and Valenciennes, and that of the *Trachypterus vogmarus* or *bogmarus* by Professor John Reinhardt of Copenhagen, contained in the Supplement to the 1st edition,

* Histoire naturelle des Poissons, par Cuvier et Valenciennes, tome x. pp. 314–15, and pp. 325–26. Paris, 1835.

and in the 1st volume of the 2nd edition of Yarrell's excellent 'History of British Fishes,' it was evident that it belonged to the latter species.

No unquestionably genuine specimen of this rare fish has, as far as I am aware, been hitherto found in the British seas; for the description and figure of the fishes thrown ashore in Orkney, supposed to be specimens of the deal-fish or Vaagmaer, given by Dr. Fleming* on the authority of Dr. Duguid, differ in so many important points from the Vaagmaer as must excite doubts as to their identity. Dr. Fleming is also disposed to regard as a specimen of the Vaagmaer one of the two fishes thrown ashore in the Moray Firth, and described by Mr. Hoy† as belonging to the *Trichiurus lepturus* of Linnæus, but the identity is here still more doubtful.

Its fins were of a light red colour, and the surface of the body and of the skull was of a bright leaden silvery lustre. The iris had also a silvery lustre. The greater part of the substance imparting the silver colour to the surface had been detached from one side of the body from the manner in which it had been packed up in transmitting it to St. Andrews; and though some parts of the surface of the other side had a duller lustre than others, from a cause which I shall afterwards explain, yet none was sufficiently dark or distinctly defined to constitute a dark spot similar to the two represented on each side of Reinhardt's specimen.

Its measurements were as follows:—

	ft.	in.
Length of body from point of nose to termination of the vertebral column	5	4
Height of body immediately behind the gills (not including dorsal fin)	0	8
Height of body 17 inches from point of nose	0	11
Height of body opposite vent	0	$10\frac{7}{10}$
Height of body 40 inches from point of nose	0	10
The height of the body tapered gradually from this last part mentioned to 7 inches from the termination of the vertebral column, where it began to diminish rapidly.		
Height of body 7 inches from end of vertebral column	0	3
Height of body 4 inches from end of vertebral column	0	$1\frac{2}{10}$
Height of head measured across the middle of the eyeball	0	6
Length of head (the upper jaw being fully protruded)	0	8
The circumference of the eyeball circular, and its diameter measuring	0	$2\frac{2}{10}$
Distance of vent from point of nose	2	9

The body and head were much compressed laterally, so that the whole animal was ribbon-shaped, the thickness of the upper edge being only $\frac{2}{12}$ths of an inch, that of the lower edge being

* The Magazine of Natural History by J. C. Loudon, vol. iv. p. 215, 1831.

† Linnæan Transactions, vol. xi. p. 210.

$\frac{5}{24}$ths of an inch, and the thickest part of the body where the viscera were placed measured only about 1 inch. The thickness of the most muscular part of the body immediately behind the gills and a little above the vertebral column, measured somewhat more than an inch.

In this, as in the specimen of *Trachypterus vogmarus* described by Professor Reinhardt, the height of the sword-blade-shaped body was the same or nearly the same for more than one half of its length; while in the specimens of *Trachypterus falx* and *T. iris* described by Valenciennes, the greatest height of the body was at or near the occiput, from which it gradually tapered towards the tail.

The lateral line of the body at its commencement immediately behind the operculum was nearer the upper than the lower edge of the body, but it began immediately to descend, and continued its course backwards to the tail, running nearer the lower than the upper edge. The lateral line immediately behind the gills, where the height of the body was 8 inches, was placed $3\frac{1}{2}$ inches from the upper edge; and where the height of the body was 11 inches, it was $4\frac{1}{2}$ inches from the lower edge.

It was not easy to reckon exactly the number of the dorsal rays, but I counted 176. The length of the longest dorsal ray was $4\frac{1}{2}$ inches. Only six rays were left in the caudal fin, and the longest of these was $8\frac{1}{2}$ inches. There were ten rays in each pectoral fin, and seven of these were considerably longer than the other three. The longest were from the second to the seventh, reckoning from before backwards. The length of the pectoral fin was $2\frac{1}{4}$ inches and nearly 1 inch in breadth.

A number of small cartilaginous tubercles presenting the appearance of warts was placed along its lower edge, and extended upwards from that edge $\frac{4}{12}$ths of an inch. The largest of these were about $\frac{3}{24}$ths of an inch in breadth, and less than $\frac{1}{12}$th of an inch in height. They became perceptibly smaller about 8 inches from the end of the spinal column, and in the last 3 inches of the lower edge were altogether absent. They were composed, as ascertained by the microscope, of true cartilage. They were implanted on a very strong band composed of dense fibrous tissue stretching along the whole lower edge of the body. Along the line of junction of the cartilaginous and fibrous tissues, there was a thin layer of fibro-cartilage. From the upper edge of this fibrous band a fibrous lamina ran upwards and became continuous with the fibrous lining membrane of the cavity of the abdomen, and behind the abdomen it extended upwards along the mesial plane of the body to the vertebral column. The lateral line is formed, as was ascertained by microscopic examination, by a longitudinal band of a peculiar tissue to be afterwards described, which follows the

course of the bodies of the vertebræ, and runs parallel to the mesial line of the bodies of the vertebræ in that part of the body of the animal occupied by the anterior caudal vertebræ, but on proceeding backwards it tends a little downwards, so that for the last 9 or 10 inches of its course it lies immediately below the lower edge of the bodies of the last caudal vertebræ, and at its termination meets its fellow of the opposite side at the lower edge of the body. Opposite each vertebra this tissue is thickened, forming a series of small, irregular-shaped, slight elevations lying in the course of the lateral line, from the centre of each of which in the neighbourhood of the tail, but there only, there projected a small, hard, sharp spine curved forwards. Many of these elevations have a puckered or stellated appearance. When the colouring matter on the surface is rubbed off, the small tubercles on the surface of the chorion or true skin are brought more distinctly into view. These tubercles are small and placed near to each other. From nine to fifteen of them may be counted lying in, or nearly in, the same line in a space of an inch in length. They vary from $\frac{3}{24}$ths to $\frac{1}{24}$th of an inch in length in their longest diameters, and are very slightly elevated above the surface of the chorion. The largest are about $\frac{3}{24}$ths of an inch in length, and $\frac{2}{24}$ths in breadth. The larger are placed in parallel rows, a double row running in the course and nearly through the whole length of each interneural spine*, beginning at the upper edge of the body, and terminating opposite the part where the interneural spines dip downwards between the upper extremities of the spinous processes of the vertebræ to be united to them by fibrous tissue. The smaller and much more numerous tubercles are about one half the size of the largest, are scattered irregularly in the intervals of the double rows and over the rest of the surface of the body. These tubercles differ in their intimate structure from those more prominent ones arranged along the lower edge in the manner to be afterwards described.

As the varied relative heights, at different parts of the body, of the space between the lateral line and the lower margin of the body, that between the lateral line and the upper extremities of the spinous processes of the vertebræ, and of that between the upper extremities of the spinous processes of the vertebræ and the upper margin of the body or that occupied by that portion of the interneural spines placed above the upper extremities of

* The term *interneural spines* applied by Professor Owen to the interspinous bones is used here, for the structure referred to is not in this fish composed of osseous tissue as in the osseous fishes, but of cartilaginous and a peculiar tissue, and is in all respects so unlike bone, that I feel a great reluctance to give them the name of bones. No doubt the term 'spine' is not an appropriate one either, but it is less incongruous than that of 'bone.'

the spinous processes, can be ascertained by external examination when the colouring matter of the skin has been rubbed off, and may be useful in identifying the species, I have subjoined a few such measurements. Immediately behind the occiput the spinous processes are decidedly longer than the interneural spines.

	From lateral line to lower margin of body. In inches.	From lateral line to points of spinous processes.	From points of spinous process to upper margin of body.
Five inches behind occiput (measured along lateral line)	$4\frac{4}{10}$	3	$2\frac{1}{10}$
Ten inches behind occiput	$4\frac{5}{10}$	3	3
Midway between vent and occiput	$4\frac{7}{10}$	$2\frac{2}{10}$	$4\frac{1}{10}$
Opposite vent	$4\frac{7}{10}$	2	$4\frac{1}{10}$
Midway between vent and termination of caudal vertebræ	$2\frac{1}{10}$	$1\frac{2}{10}$	$2\frac{8}{10}$
Nine inches from termination of caudal vertebræ	$1\frac{6}{10}$	$0\frac{9}{10}$	$1\frac{9}{10}$

The great length of the interneural spines causes the spinal column to be placed nearer the inferior than the superior edge of the body through the greater part of its length.

In the intermaxillary bones of the upper jaw there were seven small, conical, curved and reclined teeth, the apices of which projected backwards, situated about $\frac{7}{12}$ths of an inch from the anterior margin of the jaw. In the lower jaw there were four teeth on the right side and two on the left, placed near the anterior margin of the jaw. Three of these on the right side were in a row, while the fourth, which was smaller, was placed between them and the anterior margin of the jaw. There were appearances of a tooth having lately been displaced from the left side of the lower jaw. The largest of these teeth measured $\frac{3}{24}$ths of an inch along their convex edge, while their apices were only elevated $\frac{1}{24}$th of an inch above the mucous membrane of the mouth. There were two teeth on the anterior part of the vomer, one considerably smaller than the other, and immediately in front of the larger, placed in the mesial line of the head, nearly of the same size as those in the jaws, also curved backwards, but more erect than those in the jaws. The outer edges of the two superior pharyngeal bones were also provided with curved sharp-pointed teeth, the apices of which looked inwards towards their fellows of the opposite side. These were longer, more erect, and not so thick at their base as those of the jaws. Two rows of processes—from six to twelve in number in each row—arranged along the convex edge of each branchial arch, one row springing directly from that edge, the other formed of smaller processes, placed immediately below this and springing from the upper part of the posterior surface of the arch, were furnished with small, sharp-pointed, slightly curved teeth. No teeth were observed in any other situation than those named above, viz. the intermax-

illary bone, the lower jaw, the vomer, the superior pharyngeal bones, and the processes of the branchial arches*.

Abdomen.—On opening the abdomen the digestive tube presented the appearance of being nearly straight throughout its whole length, but on proceeding with the dissection it was found that a loop of intestine about 20 inches in length was overlapped by a mass of cæca (pyloric cæca), which extended between 9 and 10 inches along the lower edge of the stomach and œsophagus, and was tied closely to these by folds of peritoneum, except at its anterior portion. This mass of cæca measured about $\frac{8}{12}$ths of an inch in height and $\frac{7}{12}$ths of an inch in breadth at its thickest part. On tracing the digestive tube onwards from the back part of the mouth in a straight course for about 13 inches we arrived at the pyloric portion of the stomach (Pl. XVI. fig. 1 *a*) projecting from its lower edge, forming a process or diverticulum about $\frac{7}{12}$ths of an inch in height and the same in length; and was overlapped and hid from view by the posterior extremity of the mass of cæca. The stomach was prolonged backwards beyond the pyloric portion for $2\frac{1}{2}$ inches, gradually becoming narrower, terminating in a point, and forming a *cul de sac* (fig. 1 *b*). The breadth of this first portion of the digestive tube, measured before it was opened, was about $\frac{10}{12}$ths of an inch at the anterior part and $\frac{8}{12}$ths of an inch immediately above the pyloric portion of the stomach.

At its commencement at the back part of the mouth it was narrow and only admitted the passage of the little finger, but immediately below this it became wider and measured 2 inches across when slit open. It very gradually became narrower as it proceeded backwards, and immediately above the pyloric portion of the stomach it measured $1\frac{1}{2}$ inch across. There was however no distinctly defined dilated portion at the anterior part to which the name of pharynx could be given, and there was no distinct line of demarcation between the œsophagus and stomach. The walls of the stomach and œsophagus were of the same thickness, with the exception of a slight thickening of the pyloric portion, and there was no marked difference in the appearance of the mucous membrane, to the unaided eye, in these parts. The mucous membrane was thrown into nine longitudinal folds, part of which were continued into the pyloric, and the rest into the *cul de sac* of the stomach. These longitudinal folds were very prominent in the narrow commencement of the digestive tube,

* I think it right to state, that after I had examined the external characters of this animal, circumstances prevented me from proceeding with its dissection for several months, and it was preserved during that time in a solution of bay-salt, alum, and corrosive sublimate (Goadby's solution). Several representations of it were taken by the caleotype process, soon after it came into my possession, by Dr. John Adamson.

and the mucous membrane there presented numerous prominent villi. The pyloric portion of the stomach was curved, the convexity looking backwards and the concavity forwards; it contracted gradually and terminated by opening through a narrow orifice (pyloric orifice), which projected into the commencement of the duodenum. The duodenum (fig. 1 *l*) or first portion of the small intestine ran forwards along the lower edge of the œsophagus for 9 inches, having its external surface closely surrounded by numerous aggregated cæca (fig. 1 *d*). These cæca were each about an inch in length, their shut extremities directed backwards and their open mouths forwards, were longer at the commencement of the duodenum than at its termination, and opened by numerous orifices arranged in no regular order upon the inner surface of the duodenum* (fig. 1 *l*). The duodenum became narrower at its termination. At its commencement its circumference, as ascertained by measuring it across when slit open, was $\frac{10}{12}$ths of an inch, at its middle $1\frac{1}{4}$ inch, and at its termination $\frac{5}{12}$ths of an inch. The portion of the small intestine (fig. 1 *c*) in which the duodenum terminated ran forwards for about an inch in the same line with the duodenum, then turned suddenly upon itself, and proceeded backwards along the lower edge of the mass formed by the cæca; and immediately beyond the posterior extremity of the cæca it terminated in the large intestine by a narrow round orifice formed by a funnel-shaped projection of the mucous membrane of the small intestine downwards into the commencement of the large intestine (fig. 1 *h*). The large intestine (fig. 1 *m*) proceeded straight backwards until it had arrived nearly opposite the vent, when it bent downwards to reach the anal orifice. The walls of the stomach and œsophagus were considerably thicker than those of that portion of the digestive tube placed below the termination of the duodenum, and measured about $\frac{1}{12}$th of an inch. The walls of the duodenum were thinner than those of the œsophagus, but thicker than those of the portion of the digestive tube beyond it. The inner surface of the mucous membrane of the small intestine presented a slight reticulated appearance, while that of the large intestine was thrown into numerous short and small longitudinal folds. The stomach and intestines were nearly empty, containing only a small quantity of slimy matter.

The spleen (fig. 1 *o*) was very small and round in form, was placed between the stomach and the terminating part of the small intestine, and was overlapped by the posterior cæca.

The liver extended across the lower surface of the anterior por-

* Valenciennes, in his account of the *Trachypterus leiopterus*, describes the cæca opening into the duodenum in that animal "presque sur deux rangées parallèles et opposées."

tion of the œsophagus for $2\frac{1}{2}$ inches, and stretched backwards for other 3 inches along the left side of that tube, so that on the left side it measured $5\frac{1}{2}$ inches. The gall-bladder was large.

The kidneys were 14 inches in length, were not lobulated, were much larger at their anterior extremity, and narrow and cord-like at their middle and lower parts. Their anterior extremity was placed close to the base of the cranium, and was compressed laterally and elongated from above downwards. Their middle and lower portions were inclosed in a canal formed by the transverse processes of the vertebræ and the dense fibrous membrane connecting these processes together, and the two kidneys were only separated from each other by a thin membranous partition. The ureters entered the cavity of the abdomen, about 2 inches below the lower end of the kidneys, by perforating the aponeurotic membrane which separates the kidneys from the cavity of the abdomen; they then continued their course backwards, having been united to form a single tube, along the upper surface of the abdomen, tied closely down to the aponeurotic membrane lining the abdomen. This tube, about $2\frac{1}{2}$ inches before its termination on the external surface of the body, became suddenly dilated to between twice and three times its former calibre, and this continued for 1 inch of its course, forming a small urinary bladder. The urinary tube terminated in an opening immediately behind the anal orifice.

The ovaries measured 15 inches in length, were flattened, and their greatest breadth was $\frac{9}{12}$ths of an inch, and their average breadth about $\frac{6}{12}$ths of an inch. At first sight there appeared to be only one ovary, but on closer examination it was found to consist of two plicated bands of a light yellow colour—each constituting an ovarium—occupying the edges, while the central part was formed only of the fold of peritoneum inclosing them. The ova were all in a very early stage of their development. The ovaries in the posterior part of their course were closely united to the ureter. As they were broken across accidentally at the lower part, I did not succeed in tracing the oviduct; but finding a duct joining itself to the urinary canal near its termination, I thought it probable that this was the termination of the oviduct. No air-bladder was present.

Vertebral Column.—The vertebral column was destitute of osseous texture, and contained 97 vertebræ—38 abdominal and 59 caudal—each of which was hollowed out before and behind into a cup-shaped cavity. Their lateral external surfaces presented, in general, each five longitudinal slightly elevated ridges, and the articulating edges of the cup-shaped cavities were a little more prominent than the middle part of the vertebra. In the bodies of the caudal vertebræ a prominent longitudinal ridge oc-

cupied the centre of each lateral surface. The bodies of the vertebræ were subcylindrical, and a transverse section of the body of a dorsal vertebra (fig. 3) approached an oval form, was slightly longer in its vertical than in its transverse diameter, and was considerably wider across the centre than at the upper and lower edges, where its processes were attached.

The last caudal vertebra was short and terminated in, or at least was continuous with, a vertical plate of true cartilage, as proved by microscopic examination, which was thickened along its upper edge *. Along this thickened edge the caudal fins were articulated. The superior spinous processes were in general very slender, most of them almost thread-like, and were united together by a strong dense fibrous-looking membrane (fig. 3 *a*) continuous with the laminæ or neural arches forming the spinal canal. This strong fibrous membrane was prolonged upwards along the whole length of the spinous processes and also enveloped the lower extremities of the interspinous or interneural spines. These interneural spines were very flexible, appeared to be of a cartilaginous texture, to the unaided eye, at the upper part, and of a fibrous structure at the lower part. The upper extremity of each became considerably expanded, chiefly from before backwards; divided itself into two limbs having a notch between them; and one of these limbs projected backwards, the other forwards, the former uniting itself to the anterior limb of the corresponding expansion of the interneural spine immediately behind, the latter to the posterior limb of the corresponding expansion of the interneural spine immediately in front; the whole together forming a band of true cartilage, as ascertained by the microscope, running along the whole length of the spine, and affording articular surfaces for the rays of the dorsal fin. The rays of the dorsal and the interspinous or interneural spines are articulated in this manner. On the upper surface of those parts of this cartilaginous band formed by the junction of the two limbs into which the interneural spines divide, there is a shallow articular excavation, elongated from before backwards. Into this depression is fitted a cartilaginous disc secured by ligamentous fibres in such a manner that it is permitted to move slightly in all directions. The lower end of the ray of the dorsal fin bifurcates, and embracing this cartilaginous disc is firmly attached to its lateral surfaces. The mode of articulation between the fin-rays and the interneural spines here described, is similar to that between the fin-rays and the interneural and the inferior inter-

* This plate of cartilage ought, from its structure and relative position, to be regarded as formed by interneural spines. The rays of the caudal fin were placed close to each other at their articulation to the upper edge of this plate, but diverged as they proceeded outwards like the rays of a fan.

spinal or interhæmal spines in the turbot (*Rhombus maximus*) and in the genus *Platessa*, and probably in all of the *Pleuronectidæ*. The tendons of two small muscular bundles, which run parallel to each interspinous or interneural spine, are attached on each side to the bifurcated extremity of the fin-ray embracing the cartilaginous disc. Between these two muscles a thin aponeurotic prolongation is sent inwards from the spine. At the anterior part of the body the interneural spines and the spinous processes of the vertebræ are equal in number, but towards the posterior part of the body where the vertebræ become considerably longer, more than one interneural spine is interposed between two spinous processes. The vertebræ varied in length and in their other dimensions in different parts of the spinal column. The first and second—counting from before backwards—were considerably shorter than those which immediately succeeded them. The longest were placed in the posterior part of the spinal column. The following measurements point out the relative length, and some of the other dimensions of these vertebræ:—

Number.	Length in inches.	Height.	Breadth.
1	$\frac{3}{24}$	$\frac{12}{24}$	Nearly the same as the height.
2	$\frac{4}{24}$	$\frac{12}{24}$	
3	$\frac{6}{24}$		
4	$\frac{7}{24}$		
5	$\frac{8}{24}$		
58	$\frac{10}{24}$		
59	$\frac{5}{24}$		
60	$\frac{7}{24}$		
61	$\frac{12}{24}$		
86	1	$\frac{6}{24}$	$\frac{6}{24}$
87	1		
92	$\frac{8}{12}$		
95	$\frac{7}{12}$*		

The transverse processes of the dorsal vertebræ were directed

* It is exceedingly improbable that this marked shortening of the bodies of the fifty-ninth and sixtieth vertebræ is their natural conformation, as they were nearly anchylosed by portions of cartilage which took the place of the gelatinous-looking substance occupying these cavities in the other vertebræ, and the cavities themselves were considerably diminished in depth. Valenciennes says that in the *Trachypterus leiopterus* the number of the vertebræ is ninety or ninety-one "qui ont cela de remarquable, qu'elles vont toujours en s'alongeant, et même en s'amincissant, ce qui rend les premières plus hautes que longues; vers le milieu elles commencent à devenir un peu plus longues que hautes, et la longueur de celles de l'extrémité postérieure surpasse cinq ou six fois leur hauteur."

downwards, were about half an inch in length, were very imperfectly developed, and could scarcely be distinguished in the strong fibrous membrane attached to the vertebræ along the line of junction of these processes with the bodies of the vertebræ and uniting all the transverse processes of the same row together. These two strong fibrous laminæ passed down on each side of the kidneys, and converged along their lower edge so as to form a canal inclosing them. There were no ribs present. The inferior spinous processes of the vertebræ were slender and quite flexible, presented the appearance of cartilage to the unaided eye, were united together by a dense fibrous membrane, and were directed obliquely backwards. The longest were situated opposite to the vent, and were more than two inches in length. About two-thirds of the cavity between each pair of vertebræ formed by the junction of the cup-shaped excavations before and behind, was filled up by a white gelatinous substance, of the shape of a double cone like the cavity containing it, the apices of which were attached to the bottoms of the cup-shaped excavations, and in fact extended along a canal traversing the centre of the bodies of the vertebræ, so that in this way the white gelatinous-looking substance was continuous along the whole length of the spinal column, and formed alternate bulgings and contractions,—the bulgings corresponding to the widest part of the bi-conical cavity between each pair of vertebræ, the contractions to the canal perforating the centre of the body of each vertebra. This gelatinous substance was of the same structure as that found in the corresponding position in other fishes, but it was solid throughout, and contained no cavity in its interior for holding fluid. It possessed little elasticity, was soft and readily compressed, and could be broken down or torn into fragments by the exertion of a very moderate force. On making a transverse section of the body of one of the vertebræ (fig. 3), a number of narrow bands, generally eighteen in number, are seen radiating from a point near the centre to the circumference, and one of these runs to each of the longitudinal ridges on the external surface of the body of the vertebra. These radiating bands begin at the outer edge of a ring surrounding the white gelatinous substance occupying the centre of the body of the vertebræ like the pith in the centre of the trunk of a dicotyledonous tree; and the radiating bands may be compared to the medullary rays passing from the pith towards the circumference in the tree; but they differ in this, that the radiating bands in the vertebræ are composed, as we shall point out afterwards, of a structure of a very different character from that constituting the central gelatinous substance. Fig. 3 is a representation of

the appearances just described, as observed by the aid of a common pocket lens.

The posterior, lateral and superior walls of the cavity of the cranium appear to the unaided eye to be composed of fibro-cartilage, exhibiting no traces of a division into separate portions; and a deep groove extending between the superior margins of the orbits, runs along the whole of the superior surface of the cranium, in which the elongated nasal processes of the intermaxillary bones are contained. The floor of the anterior part of this groove is occupied by the cartilaginous anterior frontal bones, which are raised into a well-marked ridge in the course of the mesial line of the cranium. The two intermaxillary bones are united at the mesial line and are prolonged outwards and downwards along the margin of the mouth to the commissure of the lips. The two nasal processes of the intermaxillaries—one from each intermaxillary—extend backwards over the middle portion of the maxillary bones, along the groove on the superior surface of the cranium as far back as the crest of the superior occipital, becoming narrower as they proceed backwards. The posterior and middle portions of both these processes lie in and are firmly fixed in a single groove on the superior surface of a portion of cartilage exceeding them in depth as well as in thickness, which also sends downwards a very thin ridge along the centre of a deep and wide groove in the anterior portion of these processes. This portion of cartilage is also grooved along its inferior surface and in the same line with that in the nasal processes of the intermaxillaries, but the former is considerably less deep and wide than the latter. These two grooves can be made to move freely upwards and downwards over the ridges on the upper surfaces of the maxillary and anterior frontal bones, and the snout can be thus protruded or retracted. The difference between the structure of the fibrous nasal processes of the intermaxillary, and that of the portion of cartilage firmly embracing their posterior and middle portions, was very well marked*. The superior maxillary bone consists of two distinct parts. First, a central part placed in front of the vomer and anterior frontals and behind the body of the intermaxillary, loosely connected to the former by fibrous tissue, and more closely, but not sufficiently so to prevent motion between them, to the latter. It was in close apposition, but not immoveably connected to its fellow of the opposite side, was about an inch and a half in length, and considerably broader at its anterior than at its posterior half, which was very narrow. The broadest part, which was a little behind the anterior extremity, was half an inch in breadth, and from its outer edge a broad thin plate of fibrous

* Is this mass of cartilage the homologue of the nasal bones?

texture was prolonged outwards and downwards towards the commissure of the lips, running posterior and parallel to the body of the intermaxillary. The inferior surface of the thin fibrous and superficial plate, with ridges on its external surface similar to the opercular bones, covering the sides of the cheeks, becomes inseparably blended with the superior surface of the lateral fibrous prolongation of the central portion of the superior maxillary. The second portion of the superior maxillary consists of two fibrous and flexible branches united together, where they are connected to the lateral part of the broadest portion of the central portion, by a moveable articulation, whence they diverge, the one proceeding to join the lower maxilla at the junction of its dental and articular portions, the other proceeding forwards and downwards to join the inferior maxilla at its symphysis. The bones of the head differed in their structure, but none of them contained ossific matter.

1. Some were composed of a thin, very flexible, fibrous lamina, presenting numerous ridges on their outer surface, arranged differently in each. This was the structure of the opercular bones, and of two quadrilateral plates, one on the surface of each cheek, placed immediately behind the anterior margin of the intermaxillary bone, united to each other by a portion without ridges on its external surface which passed over the dorsum of the snout and covered the anterior portion of the nasal processes of the intermaxillary. A thin and narrow porous layer of this tissue, apparently continued from the opercular bone, passed along the upper margin of the orbit.

2. Some were composed of a fibrous-looking tissue, either forming flexible plates and bands without any ridges, or masses of greater thickness. The palatine bones and a part of the maxillary bones consisted of thin broad plates, of this texture, while the body of the sphenoid, the anterior sphenoid, the vomer, the intermaxillary, and the central portions of both upper and lower maxillæ were formed of thicker masses of the same texture. The lower maxilla contained true cartilage in its interior.

3. Some were composed of true cartilage enveloped in an external layer of a fibrous-looking tissue. This was the structure of the lateral and posterior walls of the cavity of the cranium.

4. Some were composed throughout of true cartilage, having no fibrous envelope except that constituting the perichondrium. This was the structure of the anterior frontals, and the portion of cartilage firmly embracing the posterior and middle portions of the nasal processes of the intermaxillary.

The branchiostegous membrane is short, and contains four short, very flexible and thin branchiostegous rays, besides three others very indistinctly marked placed posterior to these.

The scapular arch is very flexible, rather slender, composed of a fibrous-looking tissue, is united to the skull at one point only —to the mastoid bone,—and is continuous throughout its whole length, so that it presents no traces of division into separate portions. About $2\frac{1}{2}$ inches from the lower edge of the body, the scapular arch bifurcates, and the two branches diverge and proceed to the lower edge of the body, and are 2 inches apart at their termination. The anterior of these two branches is the stronger, and the pectoral fin is attached to it, a little below the bifurcation.

Muscular System.—The muscular bundles of the trunk are enveloped in several strong fibrous sheaths, formed by prolongations inwards of the fibrous part of the chorion or true skin, attached to the spinal column and to the strong laminæ prolonged upwards and downwards along the processes of the spinal column. The muscles of the two sides of the body nearly throughout its whole height, are separated by a very strong fibrous partition extending upwards from the upper part of the bodies of the vertebræ along the whole length of the spinous processes, and enveloping that part of the lower extremities of the interspinous or interneural spines interposed between these processes; and extending downwards from the lower part of the bodies of the vertebræ along the transverse processes and inferior spinous processes as far as they go, and thence continued onwards to the warty-looking cartilaginous tubercles arranged along the lower edge of the body. In the region of the abdomen this partition divides itself into two parts, forming the fibrous lining of the inner surface of the abdominal walls. Three strong aponeurotic septa are sent inwards from the inner surface of the skin to that part of this central partition placed above the spinal column, and two to that part below it, throughout a great part of its length. Another septum is sent inwards from the skin along the lateral line of the body to the spinal column, which is attached along the roots of the transverse processes in the abdominal vertebræ, and to the central ridge on the bodies of the caudal vertebræ. There are thus three strong sheaths containing muscular bundles placed between the bodies of all the dorsal and the greater part of the caudal vertebræ and the upper extremities of their superior spinous processes, and two similar sheaths between the bodies of a great part of the caudal vertebræ and the lower extremities of their inferior spinous processes. The space between the uppermost of these sheaths and the superior margin of the body contains the muscular bundles which move the dorsal fin rays, and the space between the lowermost of these sheaths and the inferior margin of the body contains a thin layer of muscular fibres which is attached to the central partition, to

numerous small fibrous septa sent inwards from the inner surface of the skin, and to the inner surface of the skin. Bundles of these muscular fibres may be seen at some parts of the abdominal walls running between the skin and aponeurotic lining of the abdomen separated by numerous aponeurotic septa. Septa are also sent inwards from the inner surface of the skin to the interneural spines, separating each pair of muscles which move the dorsal fin rays, and numerous small septa are also at some places sent inwards from the skin among the muscular bundles filling up the fibrous sheaths. The strong central partition, and the fibrous prolongations inwards of the skin impart an amount of strength to the whole body, and afford an extent of firm attachments to the muscular bundles, which the imperfectly developed neuro-skeleton could not of itself have supplied. Of the three uppermost muscular sheaths, the lower one, immediately behind the occiput, is very much wider than the other two. Opposite the ninth vertebra they were nearly equal in width and measured each about $\frac{8}{10}$ths of an inch, but on proceeding backwards the upper and lower diminished in width much more rapidly than the middle, so that opposite the thirty-sixth vertebra while the middle measured $\frac{7}{10}$ths of an inch in width, the lower measured only $\frac{2}{10}$ths and the upper $\frac{3}{10}$ths of an inch. The upper muscular sheath lies over the upper extremities of the spinous processes of the vertebræ, and the portion of the lower extremities of the interneural spines and of the muscles of the dorsal fin rays interposed between these. Of the two undermost muscular sheaths, or those placed below the lateral line of the body, the one next the spine is much narrower than the lower.

The microscopic examination of the tissues of this animal furnished some interesting results.

Skin.—The skin is thin, being about $\frac{1}{48}$th of an inch in thickness, is in close contact with the subjacent muscular bundles, and is destitute of scales. It may be divided into two parts—an epidermic portion and the chorion or true skin. The more external of these, or the epidermic portion, may also be subdivided into two parts. One of these is composed of thin, narrow and elongated fibres (fig. 2), upon the presence of which the bright silver colour of the skin depends. These fibres are arranged in bundles, are firmly agglutinated together, those of the same bundle run parallel or nearly so to each other, and have one of their flat surfaces looking outwards, and the other towards the subjacent layer of the skin. A layer of similar fibres covers the anterior surface of the iris, giving it a bright silvery colour. It is very difficult to separate these fibres from each other, and in attempting this they were generally broken into fragments of greater or less size. Those of the iris were not so firmly agglu-

tinated together as those on the skin. I did not succeed in making any accurate measurements of these, but some of them were about $\frac{1}{3000}$th of an inch in breadth, the greater number however, were narrower than this, and the longest about $\frac{1}{100}$th of an inch in length. They dissolve in aqua potassæ, and when subjected to the action of diluted muriatic acid under the microscope no bullæ of gas were evolved, indicating that they are composed of animal membrane. When detached they do not exhibit any metallic lustre when examined by transmitted light, but do so when examined by reflected light. Sir David Brewster had the kindness to give me the following report upon the optical properties of these fibres :—"Having had occasion to examine by the microscope the colouring matter of different fishes, I was surprised to observe that the colouring matter of the Vaagmaer which you were so good as to send me presented phænomena different from what I had seen before. When removed from the skin and separated from the membrane with which it is connected, it was resolved into a great number of short and minute prisms, whose length was about six or eight times their breadth. These prisms had regular axes of double refraction, and absolutely disappeared under the polarizing microscope when the plane of primitive polarization was either parallel or perpendicular to the axis of the prism. The phænomena which these prisms exhibited were quite different from those shown by animal and vegetable fibres which have a doubly refracting structure. I am disposed to think that the prisms are analogous in their composition to shell. The metallic lustre which the skin of the Vaagmaer displays is doubtless owing to a great number of surfaces from which the incident ray is reflected, the rays transmitted through one prism being reflected from the surfaces of those which lie beneath it."

These fibres, which give the metallic lustre to the external surface of the body and to the anterior surface of the iris *, appear to me to be similar, but on a much larger scale, to the crystal-looking spicula which impart the metallic lustre to the scales, to the anterior surface of the iris, and to the membrane between the *choroid and sclerotic coats of the eyeball* in some fishes. The external surface of the small portion of each scale which is not overlapped by its fellows is, in the haddock (*Morrhua æglefinus*) invested by a structure bearing a great affinity to the epidermic layer of the Vaagmaer. This structure consists of a membrane or thin layer having little spots of dark pigment cells placed at short and nearly equal distances from each other, each spot presenting in general a stellated arrangement. Imbedded and fixed on the surface of this membrane are numerous small bodies,

* In the Vaagmaer I observed no metallic-looking layer between the sclerotic and choroid coat of the eyeball.

several times longer than they are broad, and measuring in length from $\frac{1}{1000}$th to $\frac{1}{700}$th of an inch, which, when detached and mixed with water, give it a milky appearance. In the colouring layer on the anterior surface of the iris and in the metallic-looking layer between the choroid and sclerotic in the eyeball of the haddock, the cod (*Morrhua vulgaris*), the flounder (*Platessa flesus*), and the common dab (*Platessa limanda*), these spicular-looking bodies are very numerous, are arranged in bundles, and are connected together by a substance having no definite structure. The colouring layer between the choroid and sclerotic has a fibrous appearance from the manner in which these bodies and their connecting substance are arranged. This layer in the iris is not so distinctly fibrous in its arrangement as that between the choroid and sclerotic. In the common dab they are, in the latter position, similar to those from the scale of the haddock. The spicular-looking bodies that give the metallic lustre to the silvery membrane lining the abdomen in some fishes, and also placed below the external integuments in others as in the haddock, are considerably smaller than those on the scales and in the eyeball. These colour-giving fibres seem to be commonly regarded as crystals. Ehrenberg states that the colouring matter of the peritoneal membrane of the fish consists of prismatic crystals ten times as long as they are thick, the longest of which are about $\frac{1}{96}$th of a line in length, but this varies in different kinds of fish; and similar crystals, but somewhat larger, are obtained from the silvery membrane of the sclerotic and of the anterior surface of the iris*. Henle † and Hannover ‡, in speaking of those in the metallic-looking layers of the eyeball in fishes, term them crystals. Mandl states that "the silvery matter disposed on the inferior surface of the scale upon a peculiar membrane consists of crystals;" and he has given a representation of them in fig. 8. of pl. 10 of his memoir on the Appendices of the Skin §.

* Poggendorff's Annalen der Physik und Chemie, Band xxvii. S. 468–9, 1833. H. Rose analysed some of this colouring substance obtained from the pike furnished to him by Ehrenberg, and arrived at the conclusion that it was a peculiar organic substance (*opus cit.* pp. 470–1).

† Müller's Archiv für Anatomie, Physiologie, &c. Jahrgang, 1839, S. 387.

‡ Müller's Archiv für 1840, p. 332.

§ Mandl's Anatomie Microscopique. Mémoire sur la Structure intime des Appendices tégumentaires, p. 89, 1840. Dr. Drummond (Transactions of the Royal Society of Edinburgh, vol. vii. p. 377, 1815), struck with the peculiar revolving movements which these spicula obtained from the scales and eyes, like so many other minute bodies when suspended in fluid, exhibit, was inclined to believe that they are endowed with "*animalcular* life." Reaumur (Mémoires de l'Académie Royale des Sciences, 1716, p. 229) has given a description of this silvery matter in the scales and the abdominal membrane of fishes, but he did not detect the form of these spicula, and he supposed that they were placed within tubes.

Though no doubt these spicular-looking bodies have the aspect of crystals and retain their shape when dry, yet I believe that they are composed of an animal texture similar to those fibres that give the silver colour to the external surface and to the anterior surface of the iris in the Vaagmaer. These spicular-looking bodies taken from all the situations above-mentioned rapidly disappear under the action of aqua potassæ, and when subjected to the action of dilute muriatic acid under the microscope, though they disappear, no evolution of gas is observed. In subjecting those from the scales to the action of the diluted muriatic acid, care must be taken to exclude any part of the scale itself, as bullæ of gas are evolved when the substance of the scale is acted on by the acid,—a result to be expected from their known chemical composition. Some of the bundles of these bodies procured from the coloured layer of the sclerotic in the common dab looked like those of the Vaagmaer in miniature.

Immediately below these fibres and placed next to the chorion or true skin there is a thin layer composed of a substance without any distinct structure, having nuclei imbedded in it. In this layer the external fibres are formed. On its surface and between it and the bundles of external fibres are numerous spots of black colouring matter, placed at short and in general regular distances from each other, imparting, I believe, the leaden hue to the bright silvery lustre of the external fibres. When this dark matter is accumulated in greater quantities at any part, the silvery lustre may give place to the dark leaden hue.

The next layer is the chorion or true skin, and may also be divided into two parts:—1. The more external of these contains the tubercles on the skin already described, and constitutes a minute network in the small interstices between these tubercles, as may readily be made out by the aid of a pocket-lens, when this layer has been detached from those above and below it. From ten to twenty bands of a dense fibrous tissue may be seen radiating from the circumference of one of these tubercles to those surrounding it, and being united by cross bands form a close network, the openings in which generally approach a round form. In the tubercles the meshes of this network expand, become united into a continuous membrane, and form their external covering. This external covering of the tubercle becomes somewhat thinner in the centre, bulges outward and forms internally a shallow rounded excavation with a well-defined edge, occupying about two-thirds of its area. A texture differing in some respects from true cartilage, but composed of hyaline substance with some indistinctly-defined corpuscles scattered through it, fills up this shallow excavation, extends outwards beyond its margin to the circumference of the tubercle, forms a small bulging or projec-

tion posteriorly, and in fact constitutes the chief and characteristic part of the tubercle. In stripping off the subjacent layer of the skin, some of those minute masses constituting the chief part of these tubercles may adhere so firmly to it as to be torn off along with it. The bands forming the network are composed of fibres so very closely aggregated, that it is only after they have been mechanically separated that the fibres become distinctly visible. 2. The lower layer of the chorion is composed of a dense areolar tissue assuming an aponeurotic appearance, the fibrous arrangement of which is very apparent under the microscope. These fibres can be readily separated from each other, and are arranged in two distinct layers, in each of which the fibres run parallel to each other, and cross those of the other layer at right angles. It is this aponeurotic portion of the skin which is prolonged inwards among the muscles to form intermuscular septa, and to assist in the formation of the muscular sheaths previously described. Properly speaking this aponeurotic layer ought not to be described as constituting a portion of the chorion, but it is so closely united to it, that it requires a careful dissection to separate them. The difference between the texture forming the network and the external covering of the tubercles in the upper layer of the chorion, and the aponeurotic fibres constituting what we have just described as the lower layer of the chorion, is very marked when the polarizing prisms have been fixed in the microscope, from the very dissimilar colours which these two textures then exhibit.

The skeleton did not contain any osseous texture, but was composed of cartilage, of fibrous tissue, and of a remarkable structure which was entirely new to me. True cartilage was found in some of the bones of the head, in the upper ends of the interneural spines, in the articulating discs of the dorsal fin rays, and in the vertical cartilaginous plate at the end of the caudal vertebræ. None of the vertebræ contained any true cartilaginous tissue, except the fifty-ninth and sixtieth, in which the gelatinous-looking substance in the cup-shaped cavities was changed into true cartilage, and which also presented the other peculiarity already pointed out of being considerably shorter than those immediately preceding and following them. The cartilaginous plate at the end of the caudal vertebræ, the upper extremities of the interneural spines, the articulating discs of the dorsal fin rays, and the bones of the head previously enumerated were entirely composed of true cartilage, while some of the bones of the head were composed of true cartilage internally, and were covered externally by a layer of the peculiar textures about to be described. True cartilage, as has already been mentioned, exists in the dermoskeleton, viz. in the warty-looking tubercles attached along the lower margin of the body of the animal. The relative amount

of the hyaline and the cellular elements varied in the cartilaginous texture in these different situations, but in most of it the nucleated cells were very abundant.

The surface of the transverse section of a vertebra (fig. 3) exhibits four different textures:—1. It is enveloped externally in a layer of dense arcolar tissue, which also lines the interior of the cup-shaped cavities at the anterior and posterior ends of the vertebra. 2. The centre is occupied by a portion of the same gelatinous-looking substance which is seen in larger masses in the biconical cavities existing between each pair of vertebræ. 3. The walls of the narrow central canal containing this gelatinous-looking substance consist of a peculiar, dense, flexible and strong structure which is prolonged outwards to the circumference in the form of rays (fig. 3). 4. The intervals between these rays are filled up by a compact but much less resisting structure, which when torn up by the needles appears to be chiefly composed of very fine fibres mixed with granules. The gelatinous substance in the biconical cavities between the bodies of the vertebræ, and filling up the narrow central canal in the body of each vertebra, is of the same intimate structure as the gelatinous substance occupying a corresponding position in the spinal column of other fishes*. The texture which forms the rays as it proceeds outwards from the centre generally assumes the form of a waving band (fig. 4), which soon begins to bifurcate and reunite alternately at short intervals, presenting the appearance of a chain (fig. 4), the links of which, however, are frequently longer in the transverse than in the longitudinal direction. This chain with single links in its turn becomes a chain with double links (fig. 5), and when it reaches the circumference of the body of the vertebra its breadth has been increased by the addition of two or three more links. This appearance of a chain is caused by the transverse section of parallel tubes of a hexagonal and quadrilateral shape (the former is the prevailing one) composed of this dense structure, and the links of the chain are the cut edges of the tubes. On making thin sections of the body of the vertebra in the longitudinal direction, a number of dark parallel lines may be observed (fig. 6 *a*) without any distinct indication of the presence of this tubular structure, and when a favourable slice has been procured, as represented in fig. 6, where the tubes have been cut across and a part of their course exhibited, the manner in which these dark lines are produced becomes apparent. The vertical walls (vertical in the position in which the portion under examination is placed) of these quadrilateral and hexagonal tubes must be much thicker than the transverse, seeing that the empty spaces of the tubes are interposed between the latter, while the former

* It is composed of large cells of irregular shape from lateral compression, having no distinct nuclei.

extend through the whole height of the tubes, and the light is transmitted freely through the transverse, and imperfectly along the lines occupied by the vertical walls. This remarkable texture enters very largely into the formation of the skeleton, being found not only in the bodies of the vertebræ but also in the inferior and superior spinous processes, in the lower and middle parts of the interneural spines, and in much the greater number of the bones of the head. It is also present in the dermo-skeleton, for excluding those bones of the head which some regard as forming a part of the dermo-skeleton, it is found in the lateral line of the body. This texture is chiefly arranged in the form of bands or plates and tubes; and in the series of little elevations placed on the lateral line of the body it forms masses, from which branches pass forwards and backwards along this line. The most frequent form in which it presents itself is the tubular. I have stated that this texture is very strong, and it requires considerable force to break it up by the needles. It is composed of a hyaline texture, having, in some parts at least, some pale indistinct corpuscles scattered through it, so that though in some respects it approaches the cartilaginous tissue, it could be very readily distinguished from the true cartilage found in some other parts of the body of the animal, chiefly from the absence of the nucleated corpuscles or cells. One of the best methods of obtaining a good view of this tissue in the vertebræ is to subject the parts containing it under examination to the action of aqua potassæ, which does not affect it, while it dissolves the surrounding texture. As this structure depolarizes the light, when Nicol's polarizing prisms are adapted to the microscope, the difference between its colour and that of the surrounding textures sometimes brings out its arrangement very distinctly. The size of the tubes formed by this tissue and the thickness of their walls varies. The walls of some which I measured in the vertebræ were about $\frac{1}{1000}$th of an inch thick, and the calibre of the tube was about $\frac{1}{170}$th of an inch in its longest and $\frac{1}{250}$th of an inch in its shortest diameter. The inferior spinous processes, and the lower parts of those superior spinous processes I examined, seemed entirely composed of this tissue arranged in the form of tubes similar to those in the vertebræ, running parallel to each other, so that a longitudinal section of them presented a number of parallel longitudinal lines with spaces between them, while a transverse section exhibited a reticulated appearance, produced by the open mouths of the cut tubes. In the upper portion of the superior spinous processes, and the greater portion of the interneural spines, it was chiefly arranged in the form of one large tube, of a circular form generally, the interior of which was, in the spinous process, filled up with a structure presenting all the appearance of cartilage having numerous nucleated corpuscles (fig. 8), while in the inter-

neural spines this tube was filled up with another texture presenting an indistinct cellular appearance having some pretty large and distinct nucleated cells dispersed through it (fig. 7), approaching the cartilaginous texture, yet decidedly differing from it*. The walls of this tube were thinner in the superior spinous processes than in the interneural spines, and in both (figs. 7 and 8) bands passed outwards from its circumference, which in the interneural spines sometimes assumed the form of the single chain, similar to what has been represented in fig. 4. Quadrilateral and hexagonal hyaline tubes, combined with a greater or less proportion of the fibrous and nucleated tissue which fills up the intervals between the rays in the body of the vertebræ, enter into the formation of many of the bones of the head, while portions of some of them, as the nasal processes of the intermaxillaries, and portions of the body of the sphenoid, and the anterior sphenoid, and some parts of the superior maxillary, are entirely composed of these tubes closely aggregated together. Several bones which consist internally of true cartilage, as those composing the posterior, lateral and superior walls of the cranium, the hyoid and inferior maxilla, are covered externally by a layer of these tubes intermixed with the fibrous and nucleated tissue. In the bones of the cranium this covering is confined to the external surface. The branches of the superior maxilla which go to join the inferior maxilla are not covered by skin, but by a dense firm layer made up of these tubes. This tubular structure also abounds in the branchial arches, in the scapular arch, in the opercular bones, and in the branchiostegous rays, all of which structures are destitute of true cartilaginous and osseous tissues.

EXPLANATION OF PLATE XVI.

Fig. 1. Part of the digestive tube slit open. The commencement of the large intestine has been detached and separated from the posterior end of the stomach: *a*, pyloric portion of stomach; *b*, *cul de sac* of stomach; *c c*, second portion of small intestine; *d*, cæca surrounding duodenum or first portion of the small intestine; *l*, duodenum; *g*, lower portion of œsophagus; *h*, valve at the termination of the small in the large intestine; *m*, commencement of large intestine; *o*, spleen.

Fig. 2. Fibres, greatly magnified, from the external surface of the skin, upon which its silvery lustre depends.

Fig. 3. Transverse section of an abdominal vertebra.

Figs. 4, 5 and 6. Representations greatly magnified of a peculiar hyaline tissue entering largely into the formation of the skeleton.

Fig. 7. Peculiar structure seen in a transverse section of the interspinous bones.

Fig. 8. Peculiar structure seen in a transverse section of the spinous processes of the vertebræ.

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* The smaller tubes formed by this dense hyaline substance, such as those in the bodies of the vertebræ, in some instances, if not in all, contain more or less of a soft substance without any distinct structure in which some granules are imbedded.